

Appl. No. 10/777,608

Attorney Docket No. 10808-119

III. Remarks

Reconsideration and re-examination of this application in view of the above amendments and the following remarks is herein respectfully requested.

After entering this amendment, claims 1-10 and 13-20 remain pending.

Objection to the Disclosure

The Office Action objected to the disclosure because of informalities found on page 2, lines 12 and 13. The Office Action suggested amendments to the specification to overcome the objection. Accordingly, the disclosure has been amended to incorporate these suggested changes, rendering the objection moot.

Claim Rejections - 35 U.S.C. § 102(b)

Claims 16-19 have been rejected under 35 U.S.C. § 102(b) as being anticipated by US Patent 6,350,694 to Chang et al. (Chang).

The Office Action states that Chang shows a method of removing chemical residues from a surface, the surface having a metal pattern formed in the dielectric substrate by a CMP process. The Office Action further states that Chang discloses a method comprising plasma etching the surface to remove a thickness of the metal material corresponding to a thickness of metal residue formed in a dielectric substrate by the CMP process being substantially thinner than a thickness of the metal pattern and removing the residue in an unintended trench at the semiconductor surface.



BRINKS HOFER GILSON & LIONE
PO Box 10395
Chicago, IL 60611-5599

- 7 -

Appl. No. 10/777,608

Attorney Docket No. 10808-119

A careful reading of Chang will reveal that Chang does not disclose the step of plasma etching the surface to remove a thickness of the metal material corresponding to a thickness of the metal residue formed in the dielectric substrate by the CMP process being substantially thinner than the thickness of the metal pattern. As shown in Figure 6 of Chang, Chang discloses the polishing of a copper pattern using CMP, where the copper pattern is embedded in a low-k dielectric. This low-k dielectric may be an organic dielectric or an inorganic low-k dielectric material (column 6, lines 56-57). During the CMP of the surface, surface irregularities (such as scratches and dishing) can be produced on the surface (column 7, lines 4-8). To remove these deficiencies, Chang utilizes a plasma edge step to the surface (column 7, lines 13-17).

To put it another way, Chang when describing the possible edging gasses, discloses removing the dielectric film. This statement means that during the edging process, the dielectric film is removed, not the metal, especially not the metal in the scratches within the surface. As the low-k dielectric is edged, the scratches are indirectly removed from the copper. Thus, by removing the underlying support for the copper within the scratches, the copper is equally removed. However, the present claimed invention greatly differs from this procedure. More specifically, the present invention directly removes the metal instead of removing a low-k dielectric as disclosed in Chang. Thus, Chang lacks the removal of a thickness of a metal material and only discloses removal of a thickness of an underlying dielectric layer. Therefore, because Chang does not disclose all the elements of the claimed

BRINKS
HOFER
GILSON
& LIONE

BRINKS HOFER GILSON & LIONE
PO Box 10395
Chicago, IL 60611-5599

- 8 -

Appl. No. 10/777,608

Attorney Docket No. 10808-119

invention, the rejection under 35 U.S.C. §102(b) is improper and should be withdrawn.

As to claims 17-19, these claims are dependent on claim 16 and are patentable for at least the same reasons given above in support of claim 16.

Claim Rejections - 35 U.S.C. §103(a)

Claims 1-15 have been rejected under 35 U.S.C. § 103(a) as being obvious over Chang in view of U.S. Patent 6,395,635 to Wang et al. (Wang) and further in view of U.S. Patent 6,114,243 to Gupta et al. (Gupta).

The Office Action states that Chang lacks the steps of the prepared semiconductor surface is exposed to a plasma and inert gas, the plasma having ions reacting with the metal residue to form a volatile gas and that the plasma comprises CF₄, NF₃, CHF₃, C₄, F₆, Br or Cl and that the claimed ranges of pressure, gas flow and temperature, specifically claimed for the scratch depth versus the metal pattern depth. The Office Action further states that Wang teaches a similar structure where tungsten is the metal used to fill the interconnect trenches and where CMP is used to planarize the structure, that the tungsten is etched to remove the metal which forms in the microscratches. Additionally, the Office Action states that Gupta teaches that Cl or F plasma may be used to etch the tungsten after a CMP process for further planarization.

First, as stated previously, Chang does not disclose directly removing the metal residue from the scratch. Chang only discloses removing a dielectric film and not the metal. Next, as to Gupta, Gupta discloses a method

BRINKS
HOFER
GILSON
& LIONE

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PO Box 10395
Chicago, IL 60611-5599

- 9 -

Appl. No. 10/777,608

Attorney Docket No. 10808-119

for removing tungsten. Gupta does not disclose removing any other type of metal other than tungsten. The presently claimed invention is not restricted to removing one type of metal, such as tungsten.

Last, claims 1 and 10 have been amended to recite that the metal trench pattern has an etched edge distance of 150 nm or less. The method disclosed in Wang states that the method cannot be applied to all devices. For example, Wang discloses that the method is typically used for semiconductor devices that have a trench pattern having an etched edge distance of 0.35 micrometers or larger. In fact, Wang explicitly states that the method cannot be applied to devices having a trench pattern with an edge distance of 0.25 micrometers or less (column 2, lines 1-14).

Neither reference, either alone or in combination disclose all the elements of the invention claimed in claims 1 and 10. Therefore, the rejection under 35 U.S.C. §103 is improper and should be withdrawn.

As to claims 2-9 and 13-15, these claims are dependent on either claims 1 or 10 and are allowable for at least the same reasons given above in support of claims 1 and 10.

Conclusion

In view of the above amendments and remarks, it is respectfully submitted that the present form of the claims are patentably distinguishable

BRINKS
HOFER
GILSON
& LIONE

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Chicago, IL 60611-5599

- 10 -

Appl. No. 10/777,608

Attorney Docket No. 10808-119

over the art of record and that this application is now in condition for allowance. Such action is requested.

Respectfully submitted,

October 13, 2006

Date



John A. Lingl (Reg. No. 57,414)

Attachments: None

BRINKS
HOFFER
GILSON
& LIONE

BRINKS HOFFER GILSON & LIONE
PO Box 10395
Chicago, IL 60611-5599

- 11 -